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TOBACCO
ITS CULTIVATION AND PREPARATION

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Tobacco plant variety "Joiner" topped for proper leaf development. Central Experimental Station, Réduit, Mauritius.

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PREFACE

Previous bulletins of the Department have dealt with the cultivation and curing of the Reunion type of tobacco by the caroting process. This bulletin gives information concerning the production of dark and bright cured leaf by other processes. It is the work of Mr. G. Corbett who has visited South Africa, Rhodesia and Nyasaland studying tobacco cultivation and is at present attached to the Department of Agriculture as Tobacco Officer, with assistance from Mr. W. H. Edwards, D.I.C., Acting Entomologist, and Mr. E. F. S. Shepherd, B.S.A., Botanist and Mycologist in the Department of Agriculture.

The development which has taken place in the cultivation of tobacco in Mauritius is very striking and it is believed that this handbook can be of great use to intending planters.

H. A. TEMPANY,
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TOBACCO.—ITS CULTIVATION AND PREPARATION

INTRODUCTION

The cultivation of tobacco is now receiving considerably more attention in Mauritius than ever before, and whereas in the past attention has been devoted chiefly to "Blue Tobacco" for the manufacture of black shag tobacco by the caroting process, and which is imported from the neighbouring island Bourbon, in considerable quantities every year; the cultivation of other varieties is now being considered, combined with differing methods of curing.

This bulletin is devoted chiefly to the cultural methods necessary for the successful cultivation of varieties other than the "Blue Tobacco" and the various methods of curing which may be adopted to ensure success. Whilst not going into descriptive detail of the cultivation of the "Blue Tobacco" and the peculiar process of fermentation which this undergoes, those desirous of fuller information on this method should consult Bulletins Nos. 9 and 15, General Series of the Department of Agriculture, (1), (2).

Before success can be hoped for, a clear understanding of the factors influencing the production is necessary, and of the different methods of curing suitable for the various types.

Tobacco culture is a highly specialised industry, and the acre value is so high as to enable measures to be taken, that could not be taken in the case of most crops, to control quality by control of environment factors.

Another point which must be borne in mind is, that the tobacco grower in the main, is catering for a luxury trade, and therefore quality is of more importance than maximum yield. As the acre value is high it is economically possible to go in for intensive culture, which is necessary to produce a leaf of high quality.

Botanical.—The tobacco plant belongs to the natural order Solanaceae, to which order such familiar plants as the potato, tomato and bringelle also belong, but to different genera of the order. Tobacco belongs to the genera which was named after Jean Nicot, in commemoration of the services rendered by him in spreading a knowledge of the plant, i.e: Nicotiana. There are almost 50 species of this genera, but the tobacco, is mainly derived from Nicotiana Tabacum, N. rustica and N. alata *Syn.* (persica) whilst the first named species supplies the major portion.

The afore-mentioned species are again subdivided into innumerable varieties and races, some of which possess the special qualities which have made their trade qualities famed throughout the world.

Today, tobacco is cultivated on every continent, the principal tobacco producing countries being the United States, Brazil, Cuba, Dominica Republic, Porto Rico, Mexico and Canada, on the American Continent; Russia, Greece, Bulgaria, Turkey, France, Italy and Czecho Slovakia in Europe; British India, China, Japan, Philippine Islands, Sumatra, Java and Turkey, in Asia; and Algeria, Nigeria, Nyasaland Protectorate, Northern and Southern Rhodesia, and The Union of South Africa, in the African Continent; whilst in Australia tobacco growing is now becoming an important industry.

The United States leads the world not only in the total production but in number and diversity of types produced. Types of leaf adapted for every form of manufacture are produced in important quantities. According to the census returns for 1919 tobacco was grown in 42 states, on 448,572 farms and the crop of 1,465.481.000 pounds was produced on 1,951,000 acres and was valued at 570.868.000 dollars. (3)

It is estimated that the world production for the period 1909 to 1913 averaged approximately 2.8 billion pounds of which the United States furnished 35 per cent. (3).

FACTORS INFLUENCING THE PRODUCTION.

As tobacco culture is so widely distributed throughout the world, it will be realised that it is grown under widely different climatic conditions and on varying types of soils. As will be shown later these two factors, *i e.* climate and soil which can be termed the environmental factors, determine to a great extent the various properties of the leaf, and the usefulness of the various forms for manufacture. It therefore follows that the commercial value of the tobaccos from various countries differs considerably, and that the type of tobacco that can be produced is governed to a marked extent by environment. These environment factors have the greatest influence on the distribution of the crop.

Climate.—The climate is a factor of great importance although not yet thoroughly understood. Oosthuizen (4) states : " at present little is known just how the type of tobacco is affected by climatic conditions, yet experience has shown that this is so. In certain parts of Cuba and Sumatra a leaf of excellent quality is grown, and yet on practically similar soils in the near vicinity, only a very inferior leaf is produced."

There are few plants so susceptible to climate eonditions as tobacco. In warm dry climates and seasons the tendency of the leaf is to be excessively gummy, resinous, of strong aroma, and when cured lacks elasticity and is inclined to be brittle, with poor combustibility. The size of the plants as a whole is reduced, but the yield of the crop is greater than is indicated by the size of the plants. The leaf also is resistent to decay during the processes of fermentation and ageing.

In districts where the rainfall is excessive, or in wet seasons, the tendency is for the plants to be large, with thin papery leaves deficient in gummy matter but with good burning qualities with weak aroma. The leaf however is very susceptible to decay during the processes of ageing and fermentation. The yield is usually less than what is indicated by the size of the plants.

The best quality of tobacco together with good yields are only obtained when climatic conditions are such as to ensure rapid and uninterrupted growth of the plant. The chief requirements are a fairly high temperature combined with an evenly distributed rainfall during the growing period, at the same time the rainfall should not be excessive. The tobacco plant does not quickly succumb to drought, but very quickly dies in a waterlogged soil. Irrigation is a means of controlling the factor of rainfall in dry districts or seasons, and the growing of the crop under irrigation will be dealt with later.

In cool districts the tendency is towards the production of a large, relatively thin leaf of weak aroma, but in warmer districts the conditions favour the production of a smaller, more aromatic leaf of heavier body.

Soil.—The physical and chemical properties of the soil however, constitute the most potent factor in influencing the development of the qualities which determine the usefulness of the leaf in the trade. The surface soil and subsoil are equally important in this respect, and generally speaking, bright tobaccos are produced on light sandy soils with a low soluble mineral content and of low water holding capacity. On a soil of this type, the leaf produced is of fine texture, light in colour and of weak aroma, and fertilizers must be used to produce a good yield. Heavier soils produce a heavy, gummy leaf which cures out a dark colour with strong aroma.

Whitney (4) states that : " The texture and physical properties of the soil influence the physiology of the tobacco plant, to such an extent as to determine and control the distribution of the widely differing distinct types of tobacco." Therefore the soil determines the class and type of tobacco, but the grade is dependent on the cultural methods employed and the mode of curing. So important is the influence of the soil on the quality of the leaf, that certain districts are noted for the special merit of their tobacco.

Taylor (5) gives the following soils as suitable for the different types of tobacco : " The ideal soil, for the production of bright tobacco should be composed of about *70 % of fine sand, together with 6 to 8 % of clay* besides silt and organic matter. The depth should be from 6 to 12 inches. The subsoil should not be impervious but at the same time should be retentive of moisture."

" For dark tobacco, the best soils contain 50% of clay with 25% of sand as well as silt and organic matter. In depth they should be from 6 to 12 inches, and the subsoil should be somewhat heavier than for bright tobacco."

Between these two types of soils are all classes on which tobacco of varying types are produced, and which are all necessary for the various processes of manufacture, although the demand for each type naturally varies.

The following analysis of tobacco soils in Nyasaland, clearly shows the difference between the soils suitable for the various types of tobacco :—

TYPICAL SOILS FOR TOBACCO (6).

	Bright Tobacco Leaf	Intermediate Leaf	Dark Leaf
Coarse gravel ...	.62 ...	.25 ...	.07
Fine gravel ...	10.2 ...	7.9 ...	2.9
Coarse sand ...	50.7 ...	40.0 ...	32.4
Fine sand ...	25.9 ...	16.8 ..	18.5
Silt ...	3.7 ...	12.7 ...	8.5
Fine silt ...	.3 ...	4.8 ...	1.3
Clay ...	9.3 ...	17.8 ...	36.8

Seasonal conditions as well as environmental conditions have a considerable effect on the produce, and as a rule, the best quality of tobacco together with good yields are only obtained when seasonal conditions are such as to ensure rapid and uninterrupted growth of plant. The chief requirements are a fairly high temperature combined with an evenly distributed rainfall during the growing period, at the same time the rainfall should not be excessive. The tobacco plant does not quickly succumb to drought, but very quickly dies in a water-logged soil.

A comparatively dry season tends to reduce the size of the plant as a whole, and also of the individual leaves, and to produce a thick, closely grained leaf containing an excess of gum, and of poor burning quality. The yield is greater than would appear from the size of the plants, and the leaf has good keeping qualities. On the other hand, a wet season tends to produce large plants with large, thin papery leaves deficient in gummy matter but of good burning quality. The yield is usually less than what is indicated by the size of the plants ; the keeping qualities of the leaf however, are very poor and are liable to injury through decay in the process of curing and fermentation.

Tobacco is also peculiarly susceptible to injury from wind storms which, if very severe, may ruin the whole crop. Warm and wet weather is the best for growth, but this weather is also more likely to favour the development of leaf spots. Hot and dry weather on the other hand is very detrimental and

if a drought occurs best results are obtained if the season is cool, but if the season is wet, the best growth will be with the temperature above normal.

In tobacco culture the returns per acre to the producer depends more on the quality of the leaf than on the actual yield, because the prices for the various grades differ so considerably. Therefore the aim of the tobacco grower is to produce a high grade leaf, rather than a big maximum total yield per acre. Generally, rank, coarse growth does not go with high quality, and therefore with maximum returns per acre. The cultivation of tobacco therefore calls for considerable care and attention, and is one of the most highly specialised of crops; moreover the acre value is sufficiently high as to justify considerable expenditure for the production of the highest grade leaf. In certain cigar types, considerable expenditure is entailed by the erection of cheese cloth shading over considerable areas of ground to protect the plant from the direct rays of the sun, an expenditure which cannot be borne by many crops.

TYPES OF TOBACCO

Tobacco is divided into types according to the method of curing, as each type of curing produces differing characteristics, therefore there are four types, i.e: Fire-cured, Air-cured, Sun-cured and Flue-cured. These types can be divided into classes according to the purpose for which the various leaf is used, such as cigarettes, pipe, cigar or chewing. In the case of cigar leaf, the class is subdivided into three classes, i.e., wrapper, binder, and filler leaf.

There are also two further distinctive types of tobacco, which may be mentioned; these are White Burley, and Turkish, both of which are used for certain purposes and they are not suitable for varying methods of curing.

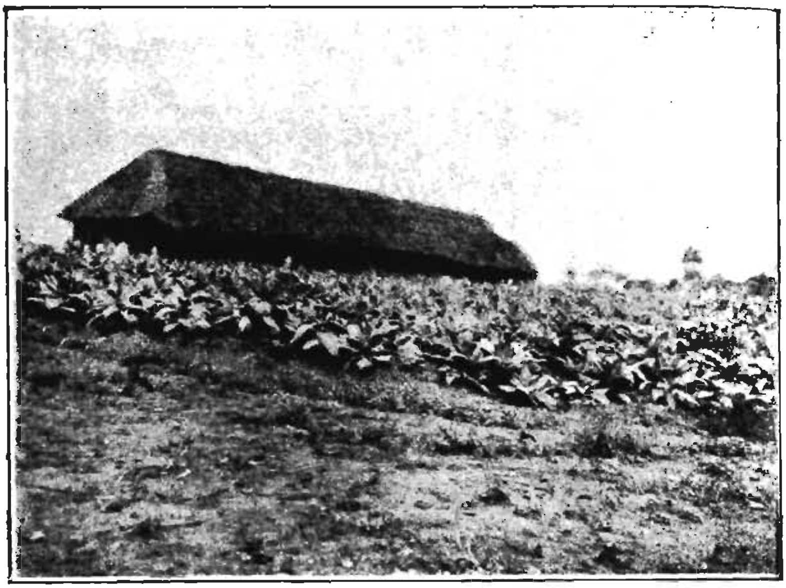
As there are differences in the cultivation necessary for the production of the various types, each type will be dealt with separately to prevent confusion, because the quality desired in the leaf for one purpose may render it useless for another. Further, quality depends largely on the environment and the methods of cultivation, curing and handling, and therefore the conditions necessary for producing the various types must be clearly understood before success can be achieved, and tobacco of a certain type produced.

SELECTION OF VARIETIES AND SEED SELECTION

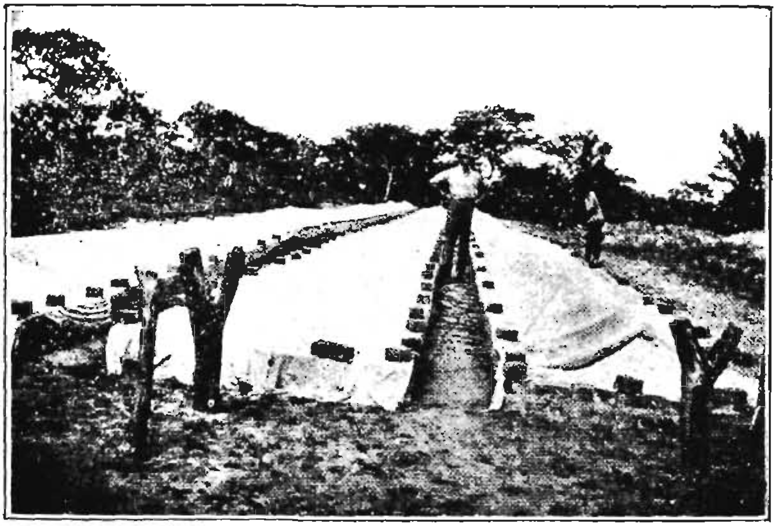
At the present time extensive experiments are being carried out with the following varieties: —Joiner, Sterling, Yellow Pryor, Blue Pryor, Gold Leaf, Root Rot Resistant Burley, Heavy Hancover Burley, Connecticut Broadleaf, Cuban and Zimmer Spanish, the last three named being cigar varieties, and in addition to these Blue Tobacco and a local variety called Constant.

Results are not sufficiently far advanced to allow of definite recommendations to be made, except in the case of Blue tobacco and Constant, both of which are suitable for air curing for the production of cigarette leaf. When definite recommendations can be made regarding the other varieties, they will be published for general information. In the meantime growers are advised to grow Blue tobacco or Constant and for which a local market exists.

The first thing necessary for the production of a true type of tobacco is careful seed selection, and unless this is carried out the tobacco produced from locally grown seeds will deteriorate, because the tobacco plant has a natural tendency to variation, and is very susceptible to environment. As a rule, the general principles governing selection are known to the majority of practical agriculturists, and that the first step is the study of the various varieties suitable for the locality. The great variation in tobacco is noticeable in any plantation, in the size and shape of leaves, the number and space



Field of White Burley Tobacco, Nyasaland. Note flower heads covered with bags to prevent cross pollination.



Tobacco seed beds. Note these beds are enclosed with brick, covered with cheese cloth to protect young plants from hot sun during the day and cold winds at night, and also from ravages of insects. (From "Illustrations of Correct Tobacco Culture" by H. W. Taylor—Bulletin 493 Depart. of Agriculture, S. Rhodesia.)

etween leaves and the colour. One of the chief causes of variation is cross-ollination between different varieties or differing plants of the same variety. t has been clearly established that the tobacco plant responds readily tc election and that a variety suitable for the conditions under which it is grown an be acclimatized in two or three years, and will reproduce true to type il election is carried out.

In any plantation of tobacco it will noticed that certain plants stand out s superior to the others, growing quicker and maturing earlier than the others. hese plants should be selected for the production of seed, providing that they re true to varietal type. The class of tobacco being produced determines the haracteristics of the plants to be selected for seed purposes, and therefore lanters should endeavour to select the plants which are best suited for the lass of tobacco being produced.

When the plants for seed have been selected, measures should be taken prevent cross pollination, and this is done by covering the flower-heads ith a large paper or muslin bag which should be tied loosely round the stem f the plant. Just before the flowers open is the correct time to place the ags in position, and if any flowers have opened prior to covering, they ould be removed. The flower head should be prepared for covering by e removal of all top leaves and suckers and only three or four terminal ower branches should be left. After covering, the flower head should be amined every week and all suckers and surplus flower branches pruned way and the dried corollas removed, also an inspection for caterpillars ould be conducted, as often the eggs are deposited on the young flower head fore covering.

Double the number of plants actually required for seed should be selected, that if any of the plants develop undesirable characteristics when approaching aturity, they can be rejected. After the plant has developed about eighty ds or capsules, the bags should be removed and all undeveloped flowers uned away.

As soon as the capsules develop a brown colour, which denotes that the ed has matured, the seed head can be cut. Care should be exercised so that immature seed is collected. On removal of the seedheads, by severing the tire head from the plant, they should be stored in a cool dry room with the ds pointing upwards until they are dry, when they can be shelled, winnowed, belled and stored in glass jars, covered with fine muslin.

Before sowing, the seed should be graded by being passed through a seed ader which separates the light seed from the heavy. This is a matter of eat importance, as it has been clearly established that plants from heavy d mature earlier and make a more even growth than those from light seeds, d are more vigorous and of larger size (7)

As the production of strong healthy seedlings is the first step towards ccesful tobacco growing, all seeds should also be disinfected to combat eases such as angular spot (Bacterium angalutum) which is present in auritius. The use of disease-free seed is the first step towards the control-g of the disease, and even if the seed is believed to be disease-free, it is a ecaution which should nevertheless be taken. The disinfection is simple to ry out, but must be properly done to ensure satisfactory results. It is done soaking the seeds in a solution of Formaldehyde, the solution being de by adding 30 c.c of 40% Formaldehyde to 600 c.c water. The seed ould be placed in a muslin bag and stirred and shaken throughout the mersion and afterwards thoroughly washed in several changes of water and ed thoroughly and quickly in the sun.

It is not expected that every grower will be able to provide a grader but graded and disinfected seed will always be obtainable from the Department of Agriculture.

SEED BEDS.

In Mauritius, tobacco can be grown throughout the whole year in certain districts, but the best months for planting appear to be December to February, allowing for seasonal variations (2). Good results have also been obtained by August and October planting. There still remains a good deal of information to be obtained as to the best time to sow, but the grower should endeavour to have plants ready for planting out when rains are generally expected in his district.

Care and attention to seed beds cannot be over emphazised as the success of a good crop depends to a large extent upon having a plentiful supply of good healthy plants for transplanting at the most favourable time.

In selecting the site for the seed beds, the following factors have to be considered:—soil, protection from winds, and water supply. The soil should be well drained and consist of light rich loam, and should if possible be level. If the soil is too heavy it can be improved by the addition of sand, spread evenly and mixed with the soil. It must be well drained to prevent saturation by water otherwise the plants will not make satisfactory progress and also be more liable to fungus disease.

There should be protection from the prevailing winds as these only serve to dry out the beds and check the growth of the plants. If there is no natural protection, it will pay to erect a screen of palm leaves or grass. The most desirable exposure is a north-easterly or easterly one, so as to allow the plants to get the maximum amount of sunlight.

The beds should be as near the available water supply as possible so as to minimise the amount of labour necessary for keeping the beds moist, as they must be kept, until the plants reach some size.

The things to be guarded against are: selecting a site close to large trees which shade the beds during part of the day; using the same site continually, as this renders the plant more liable to insect pest and fungus diseases, and the soil is less suitable owing to the heavy applications of water necessary, and the continuous sterilising. A new site is much preferable and gives better results.

The preparation of the soil consists of clearing the land of all undergrowth and rubbish, and levelling. Afterwards the land should received good dressing of old pen manure well pulverised which should be applied some considerable time before and well incorporated in the soil by digging The preparation of the soil should not be left until seed beds are required, but should be done some time before, so as to allow the manure to become thoroughly decomposed.

In the final preparation of the site, beds should be lined off with pathways between. The beds should run as far as possible north and south so as to allow the sun to shine down between them during the greater part of the day, and so prevent the paths between the beds becoming saturated with water, as is often the case. The beds should be made of a convenient size and of a width which will allow plants in the centre of the bed being pulled without treading on the bed. A most convenient size is 25 feet by 4 feet—100 square feet. They should be raised about four inches above the paths, and the beds brought to a fine tilth, when they are ready for sterilizing.

There are several methods of sterilization but the open-fire method is the best for prevailing conditions. By this method all weed seeds and hibernating insects are destroyed and the resultant ash is an excellent fertilizer, containing as it does potash, in the form of carbonate of potash which is the best potash salt for tobacco soils. In burning, sufficient brushwood should be used to burn the soil thoroughly to a depth of three inches, tobacco stalks or trash should not be used for this purpose. The best time to sterilize the beds is when the soil is moist, not when it is dry or very wet. After burning, the beds should be allowed to cool, and then all unburnt rubbish raked off and the ash which is left, lightly forked in, care being taken not to disturb the soil below the depth at which it has been burnt. The burning should be done on a calm day and not when there is any wind.

The commonest mistake met with in the case of seed beds is a too thick seeding. The usual method employed here, is first sowing the seed in boxes and then transplanting into nursery beds, but this method is wasteful of labour and the plants are checked twice in their career by the double transplanting involved.

When it is realised that an ounce of tobacco seed contains approximately 300,000 seeds, it will be readily realised that very little seed is necessary for a bed of 100 sq. feet. There are approximately 12 teaspoonfuls in an ounce, and one teaspoonful is sufficient for each bed. To sow this small quantity of seed on that area is impossible without the aid of some medium and therefore the seed should be mixed with wood ashes, mealie meal, or very fine sand before sowing, and the whole distributed evenly over the bed. The best method of mixing is to place a handful of the medium in the bottom of a tin, then a pinch of seed, another handful of the medium and so on until the seed is used up, when the whole mixture is well mixed in the tin before sowing.

After sowing this evenly over the bed, the surface of the bed should be lightly pressed with a smooth board and then watered with a very fine rose. Care should be taken not to flood the bed and so wash the seed away, but rather water the bed twice than do so.

The number of beds required depends entirely on the acreage it is intended to grow, two beds 25 × 4 ft are sufficient for supplying plants for one acre. In reckoning the number of beds required about 25 per cent to 50 per cent extra beds should be sown to allow for any attack of disease or insect pests.

Where it is intended to grow a large acreage, the beds should not all be sown at once, but at intervals of 10 to 14 days, so that all the plants are not ready for transplanting at the same time.

After sowing, the beds should be shaded against the direct rays of the sun and kept moist, not too wet, and yet not be allowed to get dry. The shading should not be done by placing grass over the surface of the bed, as is done now by a number of planters, because this covering of grass on the surface of the soil affords good harbourage for insect pests, such as red ants, woodlice etc, but it should be done either with cheese-cloth or palm leaves, and raised above the bed. Cheese-cloth or coarsely wooven hessian gives a more even shade than palm leaves or brush wood, and is not so liable to harbour insect pests. If cheese-cloth is used, it should entirely enclose the bed, being kept down at the sides by weights and raised in the centre by stretching a wire along the entire length of the bed, about 2 ft to 3 ft above the surface. By this means the temperature of the bed is kept more even and there is less chance of damage by insects and cold winds.

The shading should be kept over the beds until the plants are about the size of a rupee, when the shading should be thinned in the case of palm leaves or brush wood, and in the case of cloth, taken off for longer periods each day,

commencing the removal of the shading in the morning and gradually increasing the time it is left off until the plants can stand the rays of the sun for the entire day. During this period the watering should also be gradually reduced and when the plants are large enough for transplanting, only sufficient water should be given to prevent excessive wilting.

Just before the plants are drawn for transplanting, the bed should be well watered so as to allow the plants being drawn without damaging the roots, and after the plants suitable for transplanting have been drawn the beds should be watered again so as to settle the soil around the roots of the plants remaining in the bed, so that their growth is not retarded.

In the case of attacks of insect pests or fungus diseases, the remedial measures recommended in a later chapter should be employed.

FIELD OPERATIONS.

In an earlier chapter the effect soil has on tobacco has been discussed and so we come now to the preparation of the soil for the various types of tobacco.

In order to produce tobacco of a good quality, the plant must make rapid and continuous growth from the time the young plants strike root until they approach maturity. To ensure this the soil should be well cultivated and brought into a state of high fertility before transplanting. Not only does proper cultivation of the soil pave the way to a good yield of marketable tobacco, but also saves labour in cultivation after transplanting.

Whenever possible, the land should be dug or ploughed some considerable time before planting, and reploughed or dug just before transplanting and brought to a fine tilth. At the present time, there would appear to be an inherent dislike among a number of tobacco growers towards digging the ground for tobacco, preference is given to the method of digging holes where the tobacco is to be planted and putting manure in the hole. If tobacco of a good quality is to be produced this system of non-digging will have to disappear. It should be understood that good preparatory cultivation is more economical in labour than no preparation, and there are other advantages which also occur.

Good preparation of the soil by digging or ploughing not only allows the roots to rapidly pursue their search for nourishment, thereby placing a larger amount of plant food available, and allow air to penetrate to the roots and to the various bacteria, but also increases the capacity of the soil for retaining moisture. It is often erroneously thought that by digging or ploughing the soil more moisture is lost than by not doing so, whereas the reverse is the case and the soil absorbs the rain quicker and loses moisture more slowly.

Also good preparation keeps weeds in check, thereby saving labour for inter-cultivation, and also assists in keeping insect pests in check.

With regard to the application of manures no fixed formula can be laid down for tobacco, each type must be treated differently, and also modifications must be made according to the type of soil. The soils of Mauritius are generally heavy, naturally fertile loams, with a high content of organic matter, and with high lime requirements: in other words, the soils are acid. Whenever the soils are acid, a dressing of lime will be of inestimable value in correcting the acidity and placing certain plant foods which are insoluble and non-available, of use to the plant. The production of high quality leaf cannot be expected on acid soils. The manures for the different types of tobacco will be dealt with under their various sections.

Tobacco manurial experiments, Nyasaland. No manure plot.

Tobacco manurial experiments, Nyasaland. Complete fertilizer plot.

The planting of tobacco is usually carried out on the level in Mauritius and I do not think any advantage would be gained by ridge planting, except in districts where heavy rains are to be expected and the land is inclined to become water logged, then it would be advantageous to plant on ridges.

In dry districts where it is intended to grow the crop under irrigation it will be advisable to lay the field out in shallow furrows in which the plants will be planted. Both these methods of planting will be described in detail later.

Before planting the field should be aligned as far as possible east and west, so as to allow the sun to shine down between the rows. This is a preventative against diseases, especially "White Rust."

The best time for planting is put forward as from December to February by Auchinleck (1) but this will vary somewhat according to district. It must be borne in mind that the tobacco plant is liable to great damage by high winds and therefore efforts should be made to have the crop reaped or matured before the cyclone season is well advanced.

The plants are ready for transplanting when they are 4 to 6 inches high. The planting should be done in the late afternoon during fine weather, or on a dull, damp day, after the soil has been thoroughly moistened with rain. If it is intended to plant under irrigation the field should be laid out in shallow furrows along which the water should be led prior to planting and after planting to settle the soil around the roots. The flow of water should be such that the young plants will not be washed out.

After planting, the number of times the plants should be irrigated will depend entirely upon the climatic conditions prevailing, but it must be remembered that too much water is worse than too little.

When the plants have attained the height of one foot and the bottom leaves primed off the shallow furrows should be filled in by drawing soil from the between rows and the irrigation water should afterwards be led between the rows when necessary. When irrigation is carried out, transplanting can be done throughout the day.

The planting operation should be carried out with a wooden pin about 8 to 10 inches long and 2 inches diameter, with a tapering point. The hole should be made just large enough to take the roots up to the first bud leaf. If the roots are too long they can be trimmed back to 2½ or 3 inches. Care should be exercised that the roots are kept straight, otherwise the plant will not grow well. The distance of planting varies with the type of tobacco being grown, and will be given under each heading.

As soon as any vacancies occur they should be filled in so as to obtain an even stand throughout the field.

When the transplants have taken root, cultivation should be commenced to preserve a fine mulch on the soil surface and so prevent evaporation, and also for the destruction of weeds. Watering or irrigation should be cut down to a minimum at this time until it can be with-held, unless an excessive drought occurs. It cannot be stated definitely the number of times cultivation is necessary, the best indication being when a hard crust has formed on the surface either after rain or irrigation. The idea prevailing amongst certain growers that it is better to keep the surface of the soil hard is entirely wrong, and should not be permitted.

The first cultivation should be shallow so as not to disturb the roots of the growing plant, but when the plants begin to grow properly a deeper cultivation can be done, but the following cultivations should be shallow, and should cease when it cannot be done without fear of damaging the leaves.

As soon as the plants are 1 to $1\frac{1}{2}$ feet high, the small leaves at the bottom of the plant should be removed and discarded, this operation is known as priming. The removal of these leaves causes the plant to grow more rapidly, and allows a free current of air below the leaves, which assists to keep in check the disease known as White Rust."

FIRE-CURED TOBACCO.

The soil for the production of fire-cured leaf should be naturally fertile, well-drained, and contain high percentages of clay and silt with a low percentage of sand. The growth of the plant should be such as to produce a large gummy leaf, heavy in body, and rich in nitrogenous constituents. The heavy applications of manure or fertilizer increases the yield considerably. The nitrogen contained in the fertilizers used should be derived from organic materials. such as fish meal, and to obtain satisfactory yields of high grade leaf, fertilizers should be liberally applied. The varieties generally grown for producing fire-cured tobacco are Blue Pryor, Yellow Pryor, Gold Leaf and Clarksville. In growing tobacco for this curing the rows should be 3 to $3\frac{1}{2}$ ft apart and the plants the same distance in the row, so as to allow the plants to produce large heavy leaves.

The plants should have their bottom leaves primed as previously described, and should be topped low to produce leaves of proper size which will be heavy and oily; only eight to twelve leaves being left on the plant. The suckers which develop in the axils of the leaves should be removed weekly. Two suckers grow out from the axil of each leaf, but as these appear irregularly beginning at the top, it is necessary to go over the plants several times to remove them.

About four or five weeks after topping the plants are ready for harvesting. The plants should be allowed to become fully ripe before harvesting, and it should not be done for two or three days after rain, as the rain washes off the gum which accumulates on the leaves during dry weather, which gum, improves the body and quality of the leaf.

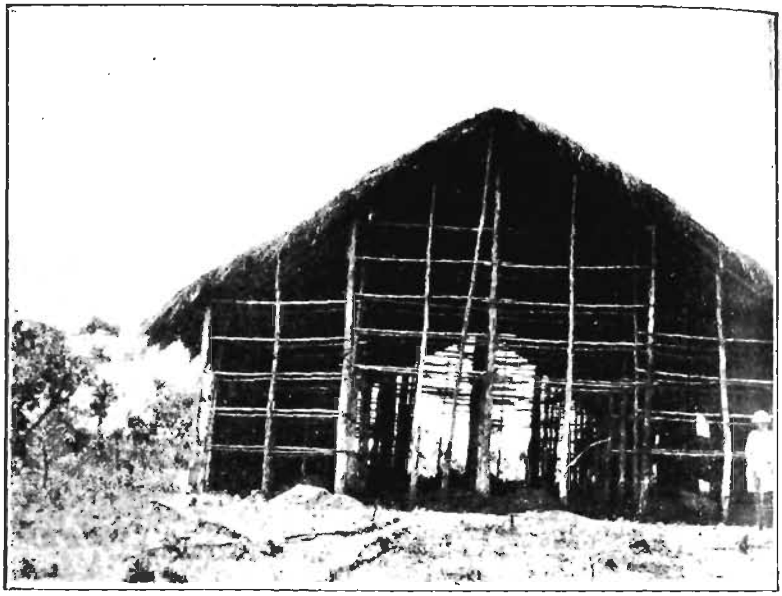
The characteristics desired in fire-cured tobacco are dappled red to dark-brown colour, of good texture, heavy bodied large leaf, oily and elastic. The method of curing is substantially the same as practised by the American Indians when America was discovered.

The barns used are simple in structure, and can be built of grass overlaid with daub and with thatched roof. The interior is arranged in tiers, 3 ft. between each tier for holding the plants. The plants are harvested by cutting the whole plant and spearing on sticks which are placed across the tiers, or a small peg about 6 inches long can be inserted at the butt of the plant, which serves to hang the plant on the rods in the barns. The barns should not be too large, but of a size to enable them to be filled in one day. Details for the erection of barns can be obtained from the Department of Agriculture.

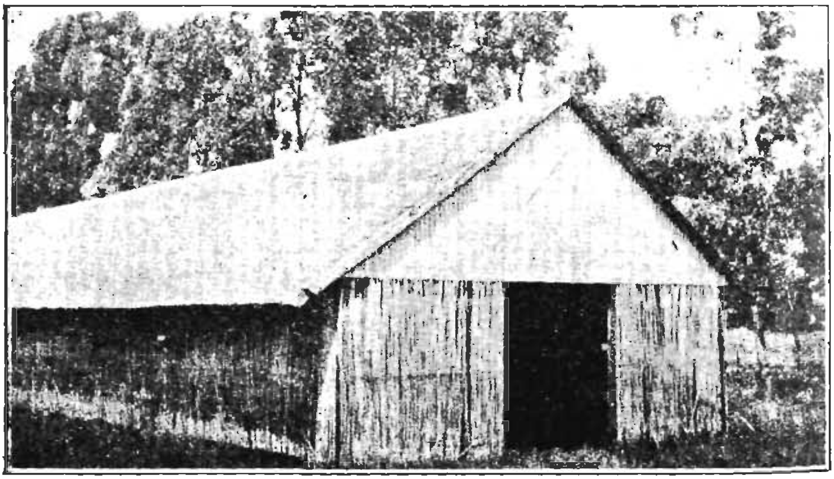
After the plant is cut and hung in the barn it is allowed to yellow before any fires are started. During this period the barn should be kept closed and the atmosphere moist, the process of yellowing usually occupies from four to six days. If wet weather occurs during this period, it may be found necessary

Tobacco plants properly primed. From "Illustrations of Correct Tobacco Culture" by H. W. Taylor—Bulletin 493 Dept. of Agriculture, S. Rhodesia.

Field of Blue Pryor Tobacco for fire curing, Nyasaland.



Fire curing shed before completion. Note the arrangement of tiers.



Air curing shed thatched—From "Different methods of Curing Tobacco" by J. du P. Oosthuizen. Reprint No. 29 of 1922 Dept. of Agriculture, Union of South Africa.

commence small fires to prevent moisture condensing on the leaf. The st temperature for yellowing is 32°C., with the relative humidity of the mosphere 85 per cent.

After the leaf has become yellow in colour small fires should be started various places in the trenches prepared for them, and the temperature of the rn increased to 35°C. The fires are only kept going during the day time d withdrawn at night, or the fires can be kept going until the tips of the ves turn brown and curl, then the temperature is increased gradually up to °C. in three days, and kept there until the web of the leaf is practically dry. e fires should then be removed when the sap from the stalk and the midrib ll spread throughout the leaf. When the leaves are pliable the operation ould be repeated until the leaf including the midrib is cured. This method oduces spangled leaf, but if an even coloured leaf is desired the fires should drawn every night, and the temperature gradually increased daily up to °C., which should never be exceeded.

The best woods for the fires are hard leguminous woods, such as Acacia, is Noir, Tamarind etc., and these should be the only ones used. The fires uld rather give a smoky heat and therefore dry wood should not be used irely. The time occupied in curing is about 3 weeks. This method is ple and appears to be admirable for the type of tobacco which is likely to produced here. The smoke from the fires imparts a creosotic flavour and uliar aroma to the leaf and at the same time improves the keeping qualities. is type is used for various manufacturing processes and is an exporting type irely.

AIR-CURED TOBACCO.

In air-curing both bright and dark leaf can be produced, but the product- of bright leaf is dependent upon the soil and atmospheric conditions vailing during the curing period.

The cultural methods as outlined for fire-curing should be adopted. The ections given for topping the tobacco for fire curing apply also to air ing, but if it is intended to produce light leaf the plants should be topped her than for dark leaf, at the same time topping too low will produce a rse rank growth.

For air-curing the whole plant is usually harvested and placed in the barn he same way as for fire curing, but the plant should be harvested just ore it is fully ripe. This method of curing is more generally adopted than r other, it is also the simplest and easiest method, consisting as it does of ting the plant and hanging in the barn until cured. The curing, even in e best barns, is dependent upon the atmospheric conditions prevailing.

The term "curing" means more than the mere drying of the leaf. Certain processes of change in both the composition and properties of the leaf must take place, otherwise the leaf will be valueless and not possess the properties charateristic of cured tobacco.

To enable these changes to take place, certain conditions must be fulfilled luring the time of curing, and the two chief factors which control the rate of uring are moisture and heat. If it is desired to produced a high percentage f cigarette leaf of light colour, curing barns which enable these two factors noisture and heat to be controlled are essential.

All tobacco now grown in Mauritius is air cured and therefore the best type of barn and the method of curing will be briefly summarised below.

Air curing consists of allowing the leaf to grow through a natural process of curing without the aid of artificial heat and the success of the curing is to a great extent dependent upon the atmospheric conditions prevailing. A good deal can be done to control these conditions by suitable barns in which ventilation is under control, and small barns give better results than large ones.

The curing goes through two stages, the first commencing when the leaf is harvested, by cutting the plant just before the majority of the leaf is fully ripe, and ends at the disappearance of the green colour which is replaced by a lemon yellow colour. It is during this stage that the barn must so regulated that the leaf does not try too quickly or too slowly. If it dries quickly the leaf will retain its green colour and be of little value, and if too slowly the curing will be carried too far. This stage is really a process of slow starvation and the most favourable conditions are obtained with a temperature of 28°–38° C. and a humidity of 35%.

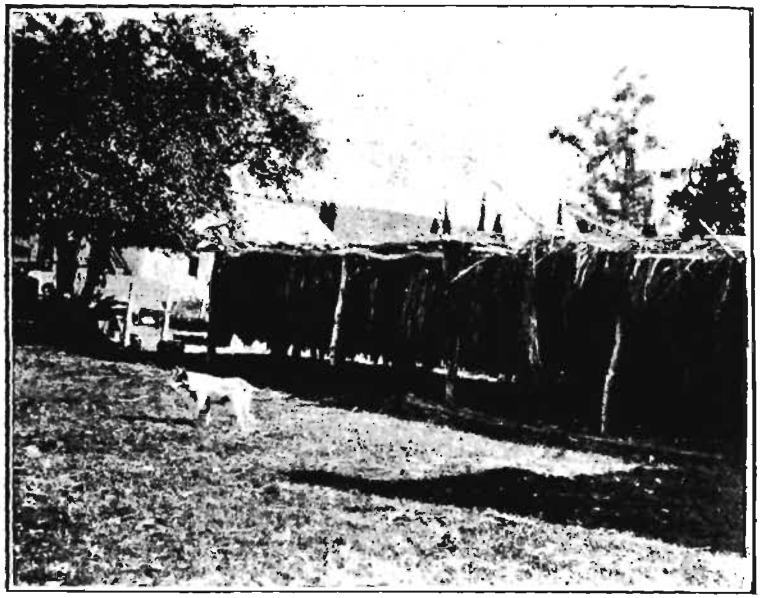
From this stage the leaf passes to the second stage and in order to get the bright leaf the curing must be hastened by reducing the moisture in the barn and hastening the drying. This is a difficult matter during wet weather and the leaf during such times will invariably becoming a dark colour, but in a good season by careful ventilation at the top and bottom of the barns a good percentage of leaf suitable for manufacture of cigarettes will be forthcoming.

During wet spells a good percentage of the leaf can be saved by building small charcoal fires under the tobacco, the heat will prevent the curing being carried too far by excess of moisture. By raising the temperature of the barn 20° Fah. the capacity of the atmosphere to hold moisture is doubled and if it is possible to keep the temperature of the barn 20° Fah. above the outside atmosphere during well spells, together with a little ventilation the elements can be controlled. During such a period the bottom ventilation should be reduced and top ventilation slightly increased. (8)

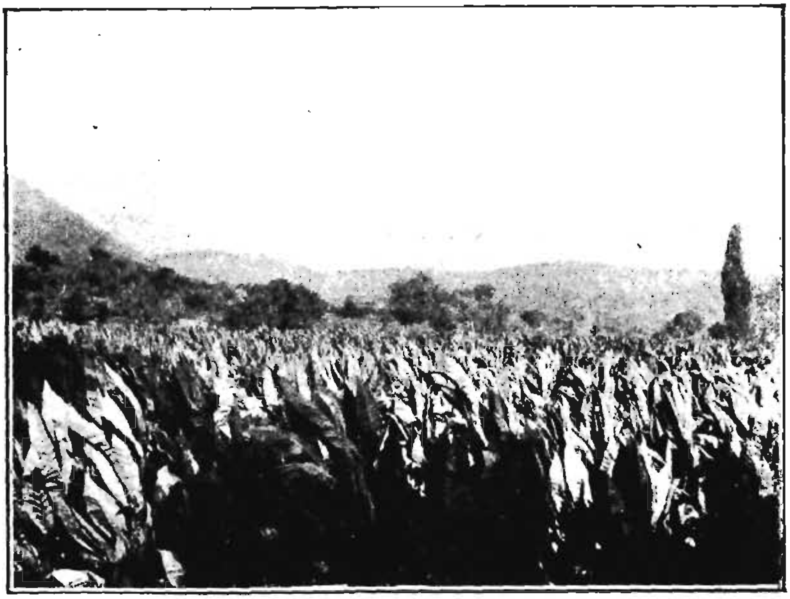
The best conditions for air-curing are clear calm days, with a moderately dry atmosphere and a temperature of 26 to 32°C. Under such conditions the moisture is absorbed by the atmosphere as quickly as it is given off from the leaves and therefore oxidation does not take place.

During dry weather when the leaf is inclined to dry out a green colour, moisture should be introduced by wetting the floors of the shed during the first stages of curing, and the colour will depend on the way moisture is withdrawn during the second stage.

The best type of barn is one which can be filled in one or two days, and should be fitted with good ventilation at the bottom and the top, so that the barn can be entirely closed if desired. A good size for a plantation of 5 acres or more is 32 ft. by 16 ft. by 7 ft. to sill, inside measurements. The interior of the barn should be fitted up with tiers which greatly facilitates the work. Advice on the building of barns can always be obtained from the Department of Agriculture and if desired a visit of the Tobacco Officer will be made to any plantation to advise on the spot.



Sun curing in Cape Province, South Africa.



Field of tobacco for sun curing in Cape Province, South Africa.

SUN CURING.

This method of curing has been practised in a few counties of Virginia and the type of tobacco produced goes under the name of Virginia sun-cured. Turkish tobacco in South Africa is also sun-cured, and this curing is also carried out to a small extent in Rhodesia. Sun-curing is similar to air-curing in that no artificial heat is used, but the two methods differ in that the curing is hastened by exposing the leaf to the direct rays of the sun in the one case, and in the other the curing is done in barns, but the rate is regulated by the atmospheric conditions prevailing, in both cases.

The methods of cultivation described for air curing are suitable for this method also. The whole plant is harvested for sun-curing just before the leaves are fully ripe, then placed on sticks which are hung in the wilting room until the leaf has yellowed, or where no barn or wilting room is available the sticks are hung on scaffolds outside, but covered until the leaf yellows, when the covering is removed. When the leaf in the wilting room has yellowed it is exposed to the sun by placing the sticks on scaffolds outside, but some form of covering must be available to protect the tobacco from rain and dew at night. Sail cloth answers the purpose well. When sun curing is practised the grower should time his crop for harvesting during the month when the least rain is likely to be encountered.

This type of tobacco possesses certain desirable qualities as compared with air cured leaf. The leaf is more uniform in colour, sweeter, more aromatic and is usually lighter in colour. It is however very susceptible to mildew and therefore great care must be taken, in packing for market, that the leaf is in proper condition, and should be packed with a lower moisture content that the other types.

FLUE CURED.

This type of tobacco is produced on soils consisting of a high sand content and low clay, silt and humus content. These types of soils do not exist in Mauritius, and therefore the likelihood of flue-cured leaf being produced is very remote. Only a brief outline of the cultural methods and curing process necessary will therefore be given.

Tobacco leaf which is flue cured varies in colour from lemon yellow to mahogany, although the percentage of yellow leaf is highest. The leaf is fine, good body, low nicotine content, mild in flavour, is aromatic and keeps well. It is chiefly used for the manufacture of cigarettes, pipe tobacco and chewing plug, and the demand for this type is great.

The soils necessary for the production are light sandy soils of fine texture, otherwise if the soil is coarse, leaf of a very indifferent quality will be produced. The soils with a high clay and silt content are unsuitable for the production of this type. The preparation of the land is the same as described previously, but as the soils on which this tobacco is produced are naturally unfertile, applications of fertilizers are necessary. Too much nitrogen must not be applied otherwise the leaf will become coarse, late in maturing and unsuitable for this method of curing.

The operation known as priming is carried out as previously stated, but the plant should be topped higher than is done for fire-curing. No fixed rule can however be laid down, the general tendency is however to top too high

which only increases the percentage of short leaf, on the other hand if topped too low, the leaf will become rank and coarse, and cure badly.

The leaf should be harvested for flue curing when it is fully ripe, and this is usually carried out by the single leaf method, that is, the leaves are harvested as they ripen from the bottom upwards. As the leaves are harvested they are placed in suitable containers and conveyed to the stringing shed. Care should be taken not to damage the leaf and covering should be provided to the containers to prevent sunburn. Leaves at the same stage of ripeness should be harvested as far as possible. In the stringing shed the leaves are placed on twine, one end of which is fastened to a stick of the size necessary for the racks in the barn and they are tied in pairs. The method employed is to take the pair of leaves in the left hand, the string being in the right, place the leaves close to the stick and the end of the string which is fastened, and the string is then wrapped round the butts one and half time, the leaves then being placed across the right hand and allowed to lie the other side of the stick, this forms a draw twist. The next pair are placed the other side of the stick, so that each alternate pair balance the stick. Each stick will hold 16—18 pairs on each side or 32—36 leaves. When the stick is full, the loose end of the string is made fast.

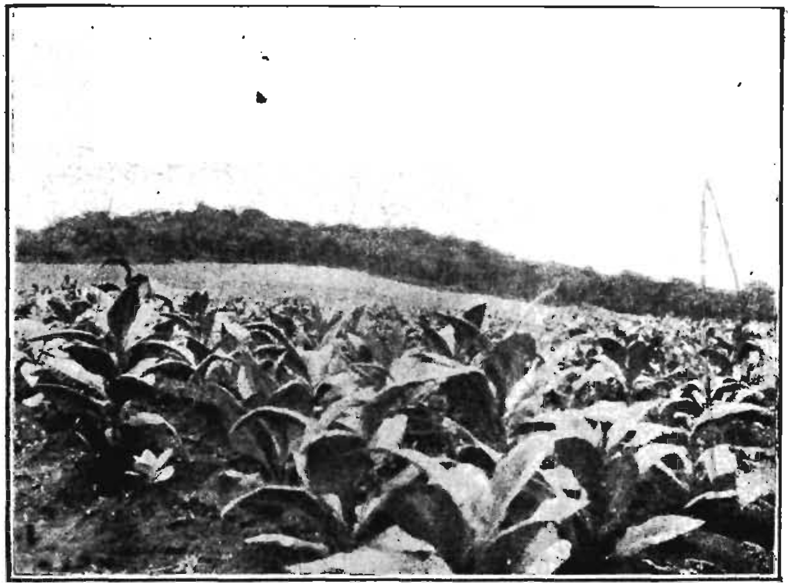
These barns are best built of brick and small barns give better results than large ones, a good size is 16′ square by 20′ high. The barn must be filled in one day, therefore the smaller barns require less labour than the larger ones to fill, and there is also a greater chance of getting the leaf of the same stage of ripeness.

Details for the construction of barns can be obtained from the Department of Agriculture, together with plans. Although more expensive than other barns, this type of barn, where suitable tobacco can be grown for this type of curing, will cure more leaf in a season than the others. In this method the curing process is governed and regulated by the use of radiated heat from flues which pass right round the barn, the heat being generated by fires outside. The heat is applied continuously from the commencement until the tobacco is thoroughly dry. This type of curing requires more care and attention than the others, and only by experience can it be learnt.

The objects sought after are to hasten the yellowing of the leaf and when the proper colour has been obtained to so govern the curing process that no further change in colour takes place. The curing undergoes three stages, i.e. yellowing, fixing the colour and drying out the leaf. The whole process occupying from four to six days.

No definite formula can be given for this method of curing as the conditions under which the tobacco has been grown and the atmospheric conditions prevailing at the time have their effect on the curing. The following information set forth therefore must be modified to suit the conditions prevailing.

During the first stage of curing, i.e., the yellowing of the leaf, the barns, must be kept closed and the atmosphere moist and a hygrometer should be placed in the centre of the barn level with the lower tier of tobacco. The fires are started and the temperature gradually increased to 32°C.. If the temperature becomes too high the leaf is killed before the colour has changed from green to yellow. This temperature is maintained until the yellow colour appears round the edges when the temperature should be increased to 35°C, and kept there until the colour begins to spread. When the colour begins to spread throughout the leaf the temperature is increased to 38°C. During the whole of this period, the atmosphere of the barn should be humid and the depression



Field of Gold Leaf for flue curing in Nyasaland.

Stringing leaves on rods for flue curing barn, Nyasaland.

Rod of leaves ready for barn. Variety "Hickory Pryor."

tween wet and dry bulbs of the hygrometer should be only 1.5 to 2°C. id' if the atmosphere becomes dry moisture must be introduced by wetting ie floors and walls, or by placing wet sacks on the flues.

As soon as the leaf begins to show a yellow colour, the temperature iould be increased to 43°C., and held until the leaf shows a distinct yellow ilour, when the temperature should be increased to 46°C, and held until the eaf takes on the proper colour. During this period, the moisture in the barn hould be gradually reduced until the pressure of the wet bulb is 2 to 3 egrees C. below the dry bulb.

When the leaf has taken on the desired colour the barns must be so nanaged that no further change in colour takes place. This period is the most ritical stage in the curing aud is known as fixing the colour, and requires nost careful attention. The proper conditions are realised when the moisture s absorbed by the atmosphere as quickly as it comes to the surface of the leaf. 'o enable this to take place the ventilators top and bottom are slightly opened nd the temperature maintained at 46°C. until the tips begin to curl when the emperature should be increased to 49°C., and held there until the leaves begin o curl in towards the midrib ; this is an indication that the leaf is drying. 'he temperature is now increased to 52°C., until the leaf appears to be dry, 'hen the colour is fixed.

To dry the leaf thoroughly the temperature is gradually increased to 4.5°C., in two hours and held for four hours when it is increased to 57°C., in ne hour, and held for four hours. The web of the leaf should now be dry. 'he ventilation is now reduced and the temperature increased two degrees per our up to 65.5°C., and held until the midrib is dry enough to snap when ent between the fingers, when the curing is finished. This formula is only ut forward as a guide and must be modified to suit varying conditions ccording to the person's judgment during the curing.

It must be pointed out that excessively high temperatures are detrimental the leaf, rendering it brittle and taking away the bright colour of properly cured leaf. The temperature should never exceed 68° C., at any time.

The rate of curing is also influenced by the atmospheric conditions prevailing, higher temperatures being required during wet weather than in dry weather, and lower temperatures are required in cool weather than in warm. The condition of the outside atmosphere has to be taken into consideration during ventilation. If the atmosphere is very dry the amount of ventilation should be reduced, top ventilation being decreased to a minimum to prevent the leaf drying too quickly, and during wet weather the bottom ventilation should be reduced and top ventilation increased in order that the moist atmosphere may be driven out of the barn. The handling of the leaf after curing is dealt with in a later section.

CIGAR TOBACCO.

Cigar tobacco is divided into 3 classes, viz : Wrapper, Binder and Filler leaf. The names indicate the uses to which the different classes are put, the wrapper being for the outer covering of the cigar, the binder holds together the filler before it is encased in the wrapper, the filler being the bulk of the

cigar. Each class has certain characteristics which determine the purpose for which it is used. The wrapper leaf must be thin, elastic, rich in grain and with no flavour, the veins must be small. The filler leaf must be heavier in body, rich in flavour and of pleasing aroma. The binder leaf is between the two, being too heavy for wrapper purposes and not fulfilling the qualities necessary for filler leaf. Irrespective of the use to which the leaf is to be put all cigar tobacco must burn freely, and evenly, with a good ash which should be of even colour and compact.

The production of each of these classes require different soil and treatment to obtain best results. The wrapper tobaccos are usually grown on fine sands and sandy loams containing only a small percentage of clay and sand. A good rainfall is also essential. The filler leaf is generally grown on heavy soils, with a low lime requirement, whereas binder leaf is generally produced on light clay loams naturally fertile.

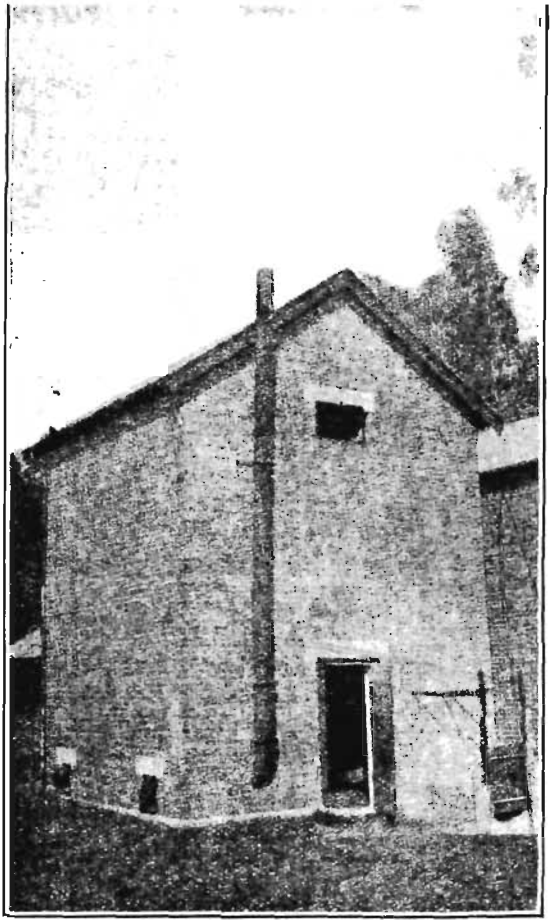
In order to produce wrapper leaf, the plant must make rapid and continuous growth, therefore heavy application of fertilizers are made. Garner (7) recommends for the production of wrapper leaf, in Connecticut valley, an application of 10 to 20 tons of stable manure ploughed under in the autumn. "When manure has been used, an application of fertilizer should be made consisting of 1 ton per acre of a high grade mixture analysing about 5 % Nitrogen, 5 % Phosphoric acid and 5 % Potash.

For filler leaf, the soil is fertilized at the rate of 1,000 lb. per acre of a mixture analysing 4% Nitrogen, 9% Phosphoric acid and 8% Potash according to the same authority. The same formula is also suitable for binder leaf. (7)

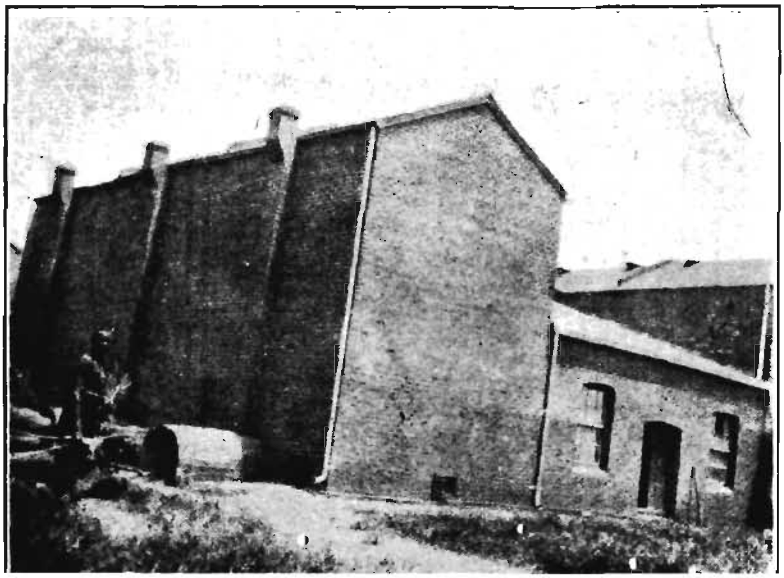
These formulas for manures are only put forward as a guide and must be modified to suit the different soils, and also the method of application governs the amount necessary. If the fertilizer is applied broadcast a greater amount is necessary than if applied in drills where the plants are to be planted. The nature and fertility of the soil governs the application of the fertilizers and the amount necessary, and no definite formula can be given for every soil for each class of leaf. The cultural operations as previously described should be carried out thoroughly for the production of cigar leaf, the transplanting is just the same as for other types, but the distance between the rows and the individual plants depends upon the class of the leaf to be produced and the variety. The spacing for wrapper leaf, should be such as to prevent rank, heavy growth, otherwise the leaf is unsuitable for wrapper purposes.

The varieties suitable for the various purposes are: for wrapper tobacco—Connecticut Broadleaf, Cuban; for filler tobacco, Cuban, Zimmer Spanish; and for binder leaf, Connecticut Havanna. Of these varieties, Connecticut Broadleaf, Cuban and Zimmer Spanish are obtainable in Mauritius. In the case of Connecticut Broadleaf and Zimmer Spanish the rows should be 42 inches apart and 24 to 30 inches between the plants, but in the case of Cuban the rows should be 36 inches apart with 18 inches between the plants, and the same distance for the variety Connecticut Havanna.

Cultivation must be thorough in order that the crop may be grown without a check if possible, and the cultivation on the lines laid down previously should be thoroughly done, so as to preserve a fine mulch on the surface so that the plant will have full benefit of all soil moisture. The height of topping varies and in some cases, topping is not done. For the production



Flue curing barn, South Africa. From " Different methods of Curing Tobacco " by J. du P. Oosthuizen. Reprint No. 29 of 1922 Dept. of Agriculture, Union of South Africa.



of wrapper leaf, when tobacco is grown under shade no topping is done, and the Cuban is topped very high. This is done to prevent the production of coarse and heavy leaf, and to produce a high percentage of fine thin leaf. To produce filler tobacco the plants should be topped at 12 to 16 leaves and at about the same height for binder leaf. After topping all suckers should be removed as they appear.

The method of harvesting varies with the type of leaf harvested wrapper leaf is generally harvested by the single leaf or priming method and should be harvested slightly on the green side rather than allow the leaves to remain too long on the plant. Leaf which has been allowed to become over-ripe lacks elasticity and appearance, being dull in colour. On the other hand, filler leaf must be allowed to become fully ripe before harvesting or it will lack flavour and aroma. This as well as binder leaf is harvested by the whole plant system.

In harvesting by the single leaf method, the first or bottom leaves are removed soon after the flowers open and the remainder at intervals of five or six days. Generally four or five pickings are required, the first comprising the lower three or four leaves of marketable size, and three or four leaves are removed at subsequent pickings.

As the leaves are picked they are placed in baskets and conveyed to the stringing shed where they are strong on strings by the use of a large needle. The leaves should be placed in pairs face to face, and the strings should hold 30–40 leaves and when filled should be fastened to a rod to fit the racks of the curing barn. In filling the barns the rods should be placed six inches apart. In harvesting filler and binder leaf the whole plant is cut and hung on the rods in the racks of the barn, or speared on the rods. Each rod will hold 6 to 8 plants and the rods should be 8 to 10 inches apart on the rack. All cigar tobaccos are air-cured, but under certain conditions heat may be used with good results. Details for types of curing sheds can be obtained from the Department of Agriculture.

When the barn has been filled with tobacco, it should be closed and kept moist until the tobacco has wilted and begun to yellow. If the weather is cool, and yellowing is slow, artificial heat may be introduced by charcoal burners to hasten this process. When the leaf takes on a greenish yellow colour a little ventilation should be given to cause a free circulation of air and remove surface moisture from the atmosphere. If moist weather occurs artificial heat must be introduced to prevent condensation of moisture on the leaf, which will greatly injure both colour and texture. If hot dry weather occurs, however, care must be exercised that the leaf does not dry out too quickly.

The leaf should change in colour from green to greenish yellow, then a clear yellow, after which the brown colour appears. When the brown colour begins to appear great care must be taken with ventilation otherwise house-burn will occur. When the leaf is brown, curing should be rapid to dry out the veins and the midribs and to accomplish this, the ventilators should be opened on sunny dry days and closed at night, and if moist weather occurs artificial heat is necessary to avoid the injury to colour which occurs when the leaf becomes alternatively moist and dry.

When the leaf has been thoroughly dried out, it must be brought into condition for handling, which can generally be accomplished by having all doors and ventilators opened for one night, when the leaf will absorb sufficient moisture as to be pliable. If this cannot be done artificial moisture must be introduced either by steam or damping floors and walls. The handling of the leaf after curing will be dealt with later.

HANDLING OF TOBACCO AFTER CURING.

Virginia Tobaccos.—After the curing process has been completed, tobacco can be either increased or decreased in value according to the method of handling employed. If properly handled the leaf will improve in colour and quality but if improperly handled loss is bound to happen. When the leaf has been thoroughly dried out, it should be brought into condition for handling by allowing the leaf to become moist entirely, so that it can be handled without fear of damage. When this has been done, the leaf should be stripped from the stem if the whole plant method of harvesting has been done, or taken from the rods if the single leaf method has been employed and should be graded according to colour, and tied in hands of 12 or 20 leaves. The leaves are then bulked, each colour separately in bulks of convenient size, in a room separate from the barn which can be kept at an even temperature and the relative humidity should be about 75 per cent.

The bulks should be built on a wooden platform made from 1 inch boards, and which should be raised 4 or 5 inches so as to allow of free circulation of the air. The bulks can be of convenient length and width, and 4 to 6 feet high. This process of bulking is really fermentation which improves and evens the colour of the leaf, and improves combustibility, aroma and ash. In the case of light-coloured leaf the bulk should not hold more than 5,000 lb, for best results, but with dark leaf, often 8,000 to 10,000 lb, are put in one bulk.

In building a bulk, the row of hands should first be laid round the outside edge of the plateform, being careful to keep the butts of the hands close together and the leaves straight. This is called the outside tier. The next of this layer is laid so as to shingle over the first, lapping well over the tips of the leaves of the first tier. This is repeated until the bottom of the platform is covered. Then another layer laid on the top of this one and so on, until the bulk is from 4 to 6 feet high. When about half of the tobacco intended for the bulk has been laid down, a tube four feet long should be placed, so that one end comes to the outside and the other extends to the centre of the bulk. This is for the purpose of placing a thermometer so as to keep a record of the temperature of the bulk. The temperature is an index of how tobacco is fermenting. The nature of the tobacco, its condition, the temperature of the room in which it is bulked, and the time of the year all have their influences on the degree of rapidity with which the tobacco will heat.

If the tobacco is in high case—that is when the leaf contains a large amount of moisture—and is bulked in a warm room, and the weather is warm, it will heat up very rapidly, and the bulk will have to be taken down and the hands of tobacco well shaken out and the bulk rebuilt; the hands which have been on the outside being put in the inside, and vice-versa. On the other hand, if the tobacco is in low case, and is bulked in a moderately warm room, in cool weather, it may be two days before it begins to heat.

Each bulk should have hung on the end of the thermometer tube a small card on which should be marked the number of the bulk, the date bulked, and the temperature at stated intervals. If the temperature commences to rise rapidly, say five to eight degrees a day the bulk should be pulled down and rebuilt as previously described, and the date of rebuilding, is entered on the card. If the bulk just gradually increases in temperature, it should be pulled down and rebuilt when the temperature reaches 36°C., for bright tobacco and 41–44°C., for dark tobacco. If these temperatures are not reached, the bulk should be pulled down and rebuilt after 3 or 4 weeks. After being rebuilt the bulks still require carefully watching and after a quick rise of temperature rebuilt again, but if the temperature increases gradually it can be allowed to go higher than in the first case, if it will.

When the temperature begins to decrease the tobacco can be allowed to remain any length of time in the bulk with safety, or it can be pulled down, graded and baled. The bulking process usually takes from 3 to 4 months.

The small grower who only produces a few hundred pounds of tobacco cannot be expected to bulk his tobacco and therefore he should forward his leaf to the Tobacco Factory where this operation as described will be carried out. To growers, however, who produce a sufficient quantity of leaf and can afford to erect bulking sheds, they should carry this process out as by so doing, they will command a better price for their leaf, if properly done. By the whole process being carried out by the grower, he realises the mistakes he is making in curing it, and therefore benefits in a way he cannot do if the tobacco is just cured and sent to the factory.

For the growers who must sell their leaf to the factory the following information is put forward for their guidance in baling.

After the leaf in the curing barn has been brought into condition for handling, the leaves should be tied in hands and roughly graded according to colour, and all badly damaged leaf discarded. By grading the tobacco, a better price will be obtained than would be by ungraded leaf. The condition of the leaf should be such that the body and tips are pliable, but midribs should be breakable but not brittle. If too much moisture is on the leaf, there is a danger of heating or mildew occuring in the bale. For baling a press is necessary and it is done by first laying the hessian in the press along the bottom and up one end, and the other end protruding about a foot and the removeable end of the press closed down on it. The leaf is then laid in layers, leaves pointing from one end towards the centre, butts outwards and repeated from the other end. The tips of the leaves should now be meeting or overlapping in the centre, but if the layers were repeated in this manner, the bale would have a weak back and would tend to break or double up in the centre during handling.

To obviate this a layer is alternately placed in the centre, the butts in the same direction and not at right angles, to act as a tie. To consolidate the bale still further and to prevent undue damage, layers of slightly less thickness are placed across the ends, from corner to corner tight up, at right angles to layers below and just covering the butts. These operations are repeated until the press is full. (9)

The correct size and weight of an ungraded bale is 34 × 24 × 16 inches deep, and should not weigh more than 160—180 lbs.

CIGAR LEAF.

The handling of Cigar tobacco is similar to that previously described. The leaves are tied into hands being roughly graded at the same time, if the leaf is being sold before fermentation it should be packed into cases for despatch.

In the bulking or fermenting of cigar leaf it is first graded into light, medium and heavy-bodied leaf, as each requires slightly different treatment. The bulking shed should be as previously described, i.e even temperature, the best temperature to keep the room is 30°—33°C., with 75% relative humidity, wooden floor, and proper ventilation. To obtain best results, the heavy-bodied leaves should contain 30% moisture and light-bodied leaves should not contain more than 25–27%, or it will be damaged by excessive moisture. The different grades are bulked separately and each bulk should not contain less than 3,000 to obtain proper results. The bulks are built in the manner previously described, light wrapper tobacco bulks should not contain more than 5,000 lbs., and heavy filler bulks can contain up to 10,000—15,000 lbs., each.

During this fermentation process, certain changes take place, which develop the flavour and aroma so characteristic of the best cigar tobacco. The temperature stated should not be exceeded in the bulking, wrapper leaf should not be above 36°C., whilst filler tobacco can with safety go up to 41–44°C but should never exceed the latter temperature.

After fermentation the tobacco is ready for grading and baling. In grading wrapper tobacco, the leaves are sorted out according to size first, and after sizing the leaves are graded. First, all damaged leaves are separated from the sound ones, and then they are graded according to colour into light, medium, and dark, each colour is then graded out according to texture into light, medium, and heavy grades. This result in a very large number of grades. After being graded, the leaves are tied into hands, with raphia, as the leaves are too expansive to be used for this purpose, and are then ready for baling.

Cigar filler tobacco is graded more according to length of leaf and texture, than colour, although the latter is sometimes taken into consideration.

The method of baling depends upon the class of tobacco being handled. In Sumatra tobacco the hands are made fan-shaped, i.e, the leaves when tied in hands are folded along the midrib and carefully flattened. The hands are packed flat in the baling box to form a parcel of 150 lb. The bales are 31 x 31 inches and 10 inches thick. Bales of Sumatra tobacco are covered with matting and sewn together. The bale is then numbered and marked with the appropriate grade and weight. Before being shipped the bale is covered with strong hessian as a further protection. Low grade Sumatra leaf which is unsuitable for wrapper purposes, is stemmed and packed in "books" to be used for binders and fillers.

The best Cuban tobacco is made into carrots before being baled. In making a carrot, four hands are tied together with the heads even, and the tobacco is wrapped from head to tip with Cuban bast. After being made into carrots the tobacco is baled, each bale contains 80 carrots. The bales are then covered to prevent breaking and to maintain condition when they are ready for market. Low grade Cuban tobacco is stemmed, the portions of leaf carefully flattened out and made into pads then pressed into bales. Tobacco so packed is generally called, in the trade, "book filler" (5).

Cigar Tobacco in South Africa is generally packed into bales, similar to the bales, used for Virginia tobacco.

DISEASES OF THE TOBACCO PLANT IN MAURITIUS

CONTRIBUTED BY E. F. S. SHEPHERD, B.S.A. (MC. GILL)

The diseases of the tobacco plant which are known to exist in Mauritius are as follows :—

Mosaic, at least three kinds of leaf spots, root-knot (caused by a nematode), a soft rot of the root and stem, resulting in a wilt and caused by a bacillus, a collar rot, and a powdery mildew, the two last being of very little importance in that they are seldom encountered and occasion negligible losses where they occur

The root knot is described amongst the injuries caused by insect and other animal pests The mosaic, the leaf spots and the wilt are briefly described in the following paragraphs.

TOBACCO MOSAIC

Mosaic diseases are included in the group of the so-called "virus" diseases of plants, in that they are highly infectious, i. e. are readily transmitted from diseased to healthy plants, but their respective causal organisms, if such there be, have never been discovered or described.

Mosaic diseases take their name from the principal symptom to be observed on an affected plant, which is a mottling of the leaves, the normal green colour of which is broken into patches or areas dark and and light green in colour respectively. The alternately arranged dark green and light green irregularly shaped patches present an appearance on the leaf surface resembling a mosaic pattern in stone work. The contrast between the dark and the light coloured areas on a mosaic infected tobacco leaf is very pronounced,—more so than is the case in many other plants. The disease can be transmitted from an infected to a healthy plant merely by rubbing a leaf of the former and then that of the latter with the hand or any other part of the body. In this way workers in tobacco fields may be responsible for the spread of the disease. Tobacco mosaic can also be transmitted by certain sucking insects which feed on the leaves.

Experiments have proved that the disease is not transmitted in seed gathered from infected plants, but Lugo's (10) observations in Porto Rico pointed to the conclusion that it can be carried over from one season to the next in the soil. In this respect tobacco mosaic differs from that of the sugar cane.

The disease has been observed in an acute form in Mauritius on ratoon shoots only, that is, those which spring from buds near the ground level after the reaping of the main shoots. On virgin shoots the symptoms are not so pronounced as those on ratoons. Since, therefore, it is not usually advisable to practise ratooning in a tobacco plantation, this disease is not one that results in serious losses in this colony.

This does not imply, however, that attempts should not be made to keep under control a disease which attacks chiefly the leaves and lowers their commercial value. To this end the following measures should be adopted :—

(1) In young plantations remove and destroy all plants which exhibit symptoms of the disease as soon as possible after they become apparent. This process should be repeated every fortnight as long as the mosaic symptoms are noticed in the plantation.

(2) If, just before "topping" the plants, there are any in the field which exhibit mosaic symptoms, these should not then be destroyed, but care should be exercised to "top" the healthy plants first in order to avoid all chances of transmitting the disease in this operation.

(3) If it is desired to practise ratooning, the healthy shoots should be reaped first and the stumps of the infected plants uprooted and burnt to prevent the growth of ratoons from the latter.

LEAF SPOTS

There are at least three kinds of leaf spots of the tobacco plant in the colony, two spots brown in their early stages and developing white centres later, and one completely white.

The two brown spots are almost identical in their manner of distribution on the plant. One however, is generally of wider diameter and in its later stages with a much less conspicuous and narrower white area in the centre than the other. The larger spot has also a more angular outline.

With the smaller spot of the two has been found associated a fungus of the genus Cercospora, apparently identical with Cercospora nicotianae, which causes the leaf spot or "cercosporose" of tobacco described by Stevens & Hall (11) and others, well known in most tobacco growing countries. The Cercospora has never been found by the writer in association with the large spot, the causative organism of which has not yet been discovered here. The writer is inclined to the belief that it is of bacterial origin.

Both leaf spots are usually encountered on the lower leaves which have arrived at maturity or nearly so. If the spots are numerous the market value of an affected leaf is seriously impaired on entirely lost, due to the falling away or tearing of the dead tissue in the spots during the curing process, which gives to the cured leaf a ragged appearance. The larger spot, of unknown cause, is more destructive than the "cercosporose."

The leaf spots are rarely found in a destructive form in areas newly planted to tobacco. The best precautionary measure against the spread of the spots is to remove and destroy the leaves near the bases of the plants as soon as they become infected. Infected leaves should never be allowed to dry on the plant or rot in the soil. All leaves which may have fallen to the soil should be carefully collected and burnt, since both diseases are transmitted from one season to the next on infected leaves which have been allowed to decay in the soil.

There is also a possibility that seeds gathered from affected plants can carry infection to a disease free area. Further investigation is, however, necessary to prove this point.

The white leaf spots are smaller in diameter and are more widely scattered on the leaf than either of the other two types. They result in practically no damage to an affected leaf. There has been up to the present no organism found associated with these spots here. It is considered that they are the result of physiological disturbances in the tissues affected due to the lack of of certain nutritive elements.

THE WILT, OR GRANVILLE WILT

This disease is caused by a bacillus called Bacillus solanacearum, apparently the same organism as that named by certain writers Bacterium solanacearum, which resides in the soil and attacks the roots of the plants.

In addittion to tobacco the organism attacks tomatoes, potatoes, peppers and egg plants (bringelle) among the Solanaceae, and voehms, peas and pistache among the Leguminosae. There are doubtless many other plants,

especially of the family Solanacease, which are susceptible to the attacks of this bacillus.

The name Granville wilt, which is often applied to this disease, takes its origin from the fact that the disease was first discovered in the county of Granville, North Carolina, U.S.A.

As the names indicates, the principal symptom of the disease consist of a wilt of the leaves. These at the base of the plant are first affected, being followed in rapid succession by those towards the apex of the stem. The wilt is followed by a yellowing of the shoot, and finally by the drying up of the whole plant.

The internal symptoms consist of a discolouration of the xylem, or woody tissues, of the roots, stem and leaves which subsequently becomes dark brown and finally black in an advanced stage of the disease, when the pith and the cortex of the stem and the roots may also decay. Since the bacteria attack the plant through the roots, the discolouration and subsequent rot of the xylem and other tissues proceed from the base of the plant upwards.

The xylem being the water-conducting tissue its obstruction and subsequent decay results in an interference in the normal flow of water from the roots upwards, which in turn results in the wilting of the leaves, the chief external symptom of the disease.

If a recently attacked portion of the stem is cut transversely a dirty white or creamy ooze will be observed to exude slowly from the discoloured xylem tissues. On microscopic examination this ooze will be found to consist of numbers of bacteria, the causal agents of the disease.

The wilt of the shoot, which is constant symptom of the disease in question, can be caused by the attacks of parasites other than Bacillus solanacearum, but the diagnosis of this disease can safely be based on the association of the typical wilt of the root with the exudation of the ooze from the cut ends of affected stems.

Granville wilt can be controlled by the removal and destruction of diseased plants and a suitable rotation of crops. It is not economically possible to destroy the causal organism of this disease in a field in which it exists widespread. In a field where there are a few isolated cases of infection, however, it is advisable to remove and destroy the attacked plants as soon as the presence of the disease is noticed and to disinfect the spots on which they were growing with a solution of formalin (½%), thoroughly soaking the soil in the process, and then to cover the disinfected areas with ghunny bags for a week.

In seriously affected plantations the diseased plants should be similarly uprooted and destroyed, but in such cases, since it would not be economical to disinfect the soil, the land after the crop has been reaped should not be planted to tobacco for at least five years, during which period crops such as maize sweet potatoes, and tanias can be grown with safety.

The practice of burying the stumps and other refuse of the plants in the soil after reaping the crop should be rigourously avoided.

The tobacco planter should also remember that the nematodes causing "root knot" and the bacteria of the Granville wilt can be introduced into a healthy field in soil transported from an infected field in water, on agricultural implements or even on the feet of the field workers, and the chances of infecting a healthy field by any of these means should, by the exercise of reasonable precautions. be reduced to a minimum.

TOBACCO

INSECT PESTS

COTRIBUTED BY W. H. EDWARDS, D.I.C., F.E.S., F.C.S.

The insects which in this country attack tobacco are not numerous however those which destroy seedlings are often very troublesome. Of these the Red Ant (Solenopsis geminata) and the Cutworms are the most important.

Red Ants (Solenopsis geminata) are widespread throughout the warmer parts of the island. Though it is a gross feeder and possesses omnivorous habits it has not yet been found possible to destroy this pest by means of poison baits, as it soon recognizes them.

The nests generally built in the ground, are conspicuous on account of the extensive systems of galleries which radiate from them. A single nest near a tobacco nursery may be the cause of serious loss as the workers dig and carry off considerable numbers of seeds and young seedlings.

As soon as this kind of damage is observed the ants' nest should be searched for and destroyed by a Petrol-Creoline emulsion prepared as follows:—

Soap (Ordinary hard soap)	...	...	75 grams
Kerosene	...	...	1 litre
Water	...	...	½ „
Creoline	...	...	¾ „

This is the stock emulsion which can be preserved for a long time, it is prepared by first dissolving the soap in boiling water, to this solution the Kerosene is gradually added a little at a time, churning violently all the while with a pump or a paddle until a creamy liquid results. The creoline is then added and the whole well mixed. This stock emulsion is diluted to 2% when it is applied on the spot, and to 1% when it is to be used to disinfect the beds containing the germinating seedlings.

To destroy a nest it is important first of all to treat the periphery with the insecticide until the soil is completely soaked. When all exit for the broods have thus been closed a few water cans of the insecticide should be poured in the centre of the nest where the young ants and gravid female live.

Cut worms also may do great damage in the seed beds; these are the caterpillars of four species of night flying noctuid moths: Plusia signata and Plusia orichalcea attack specially the younger plants whilst Prodenia litura and and Spodoptera Mauritia also destroy the replants. The females lay their eggs on the leaves of low growing plants, on stones or on vegetable detritus. The young larvae which hatch from these eggs feed at night on the older leaves of the seedlings, later they attack the central bud and softer tissues of the plants which are thus ultimately destroyed.

Young cutworms remain hidden during the day under leaves and rubbish; full grown ones bury themselves in the soil from which they come out at night to sever at the groud level the stems ot young plants which they drag with them in their burrows to be eaten.

As a precautionary measure seed beds should previous to planting be freed of all caterpillars; this can easily be done by burning and sifting the soil or by soaking it with the 2% Petrol Creoline emulsion used against Red Ants.

To prevent the moths from laying eggs amongst the young seedlings they should not be allowed access to the beds, this is done by closing the nursery perfectly at night. If the seeds are sown in the open, a cloth spread from dusk

and until the morning over the beds will answer the purpose very well. In all cases the ground surrounding the beds should be kept free of vegetation so as not to offer to the pest suitable laying places in the vicinity of the young plantations.

In cases where the seedlings have become already infected, the cutworms can be destroyed by means of poison baits. In this connection chopped cactus stems soaked for 24 hours in a 10% solution of Sodium fluoride and placed between the young plants attract and poison the young caterpillars.

To kill cutworms amongst the seedlings, the beds may also be watered with the Petrol creoline emulsion diluted to 1%.

In the Island of Rodrigues Crickets also damage tobacco. These insects live in burrows in the soil, they take the young plants which they sever at night down with them in their tunnels, to be consumed. It is reported that in the Transvaal the following poison bait has proved effective against a species of crickets having similar habits—3 lb bran, green grass or lucerne, ½ lb of sugar or treacle and one dessert spoonful arsenite of soda or Paris green.

The treacle and the powdered arsenite of soda are first mixed and then sprinkled over the bran or green vegetable which subsequently is placed between the rows of plants on the beds.

In the field tobacco is attacked by a few insects, on the whole however, the damage they cause is not great.

The larva of a Moth, Chloridea obsoleta generally known by cotton planters as the "America bollworm" and by tobacco growers as the Budworm is a cosmopolitan and omnivorous insect which may cause a certain amount of damage. The moth lays its eggs on the growing bud of the tobacco plants and the larvae attack the inflorescence and later destroy the seed pods. These caterpillars may occasionally attack the leaves and even the stems of the tobacco plant but this is rather uncommon. To preserve the seeds for planting from the attacks of this pest all caterpillars should be removed from the inflorescences before these are enclosed in linen bags.

The larvae of Coelonia (Sphinx) solani Boisd; Phytometra (Plusia) orichalcea and P. chalcytes occasionally attack the leaves of tobacco in the field, but are only pests of minor importance.

The organism which cause the heaviest losses to the tobacco grower in Mauritius is not an insect but a very small Nematode worm commonly known under the name of Ellworms: Heterodera radicicola. These worms may infect the whole root system of a tobacco plant and interfere to such an extent with the normal circulation of the sap that the plant will remain stunted and assume an unthrifty appearance; its leaves rarely come to proper maturity and are of little value. The nodules found on the roots and the distorted appearance of the roots of such a plant reveal immediately the nature of the trouble.

No practical remedy has yet been found to destroy Heterodera in the field, an infected land should not be replanted with tobacco nor with any other plant which may harbour the pest for a period of four years, and in this way it is possible to stamp the pest out.

As the roots of the tobacco plants may become infected in the seed beds as well as in the fields only seedling obtained from nurseries known to be free of Nematodes should be used for planting. In this connection it may be pointed out that the practice of burning the soil employed for making the beds is to be recommended not only to get rid of cut-worms but also because it ensures the destruction of Heterodera.

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